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THE MINERAL RESOURCES OF CANADA¹

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The mines and quarries of Canada during 1910, the latest year for which complete figures are available, yielded an output valued at \$106,823,623 and furnished employment to, exclusive of those engaged in the production of placer gold and petroleum, over 62,000 men earning more than \$37,000,000 in wages.² For 1911 the total value of the mineral production has been estimated at \$102,291,686, the decrease, as compared with the figures for 1910, being probably due to labor troubles in certain mining centers.

The following table indicates the rapid growth of the mineral industry since 1886, the first year for which complete figures are available:

TABLE 1.—VALUE OF ANNUAL MINERAL PRODUCTION OF CANADA

Year	Value
1886.....	\$10,221,255
1890.....	16,763,353
1895.....	20,605,917
1900.....	64,420,877
1905.....	69,078,999
1910.....	106,823,633

During the period of twenty-four years in part covered by the above table, the annual rate of mineral production increased tenfold and marked changes took place in the proportional amounts furnished by the regions now leading in mineral bearing. In 1886 over one-half of the value of the total mineral production was furnished by the region lying east of the St. Lawrence River, that is, by southeastern Quebec, New Brunswick and Nova Scotia. If the figures for structural materials and clay products are excluded,

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² For these and other statistics see *Annual Report of the Mineral Production of Canada during the Calendar Year 1910*, by J. McLeish. Canada: Department of Mines.

the eastern region contributed two-thirds of the total, while only one-seventh came from British Columbia in western Canada.

In 1886 the coal production of the country amounted to only slightly over 2,000,000 tons. Of this total less than one-seventh was produced in western Canada and this small proportion was almost entirely furnished by the long-established coal mines of Vancouver Island. In the same year British Columbia yielded placer gold to the value of nearly \$1,000,000, but in this province lode mining was practically non-existent. In Ontario, in 1886, a small amount of copper was produced for the first time from the Sudbury deposits then being developed purely as copper mines, the valuable nickel contents of the ores not having yet been discovered. The petroleum and salt industries were firmly established in the southwestern part of the same province. In southeastern Quebec, asbestos deposits were being mined, but the total production was still comparatively low. The copper and sulphide ores of the same region were also being mined. In the Atlantic provinces of New Brunswick and Nova Scotia, the mining of gypsum, of gold and of coal was being actively prosecuted.

By 1895 the value of the total annual mineral production had doubled that of 1886. The mineral yield of each of the three chief mineral regions had increased, but at different rates. The output of the region lying east of the St. Lawrence amounted to only one-quarter instead of one-half of the total value of the mineral production, while British Columbia furnished one-third instead of one-seventh, and the output of the mineral-bearing, northern and western, portion of Ontario amounted in value to nearly one-tenth of the total.

The marked changes in the relative productions, for the year 1895, of the eastern and western parts of the country had been partly brought about by the discovery in British Columbia of the rich copper-gold ores of Rossland and of the widely distributed silver-lead deposits of the southeastern part of the same province. The changes in the proportion of the totals furnished by the different regions were due also in part to coal production, for though the coal mines of the eastern region still lead and yielded nearly three-fifths of the total tonnage, yet the higher prices received in the West raised the value of the coal produced on Vancouver Island to an amount nearly equal to that of Nova Scotia's yield. By 1895 the metallif-

erous region of northern and western Ontario had become more important, largely because of the impetus added to the development of the Sudbury region owing to the recognition of the valuable nickel contents of its copper ores.

In the five years from the close of 1895 to 1900, the mineral output of Canada trebled in value. In 1900 the eastern region furnished less than one-quarter, while the western region produced nearly two-thirds of the value of Canada's mineral output. The proportion furnished by northern Ontario had decreased to about one-twelfth. The marked advance in the production of 1900 over that of 1895 was due almost altogether to the notable increase of nearly \$25,000,000 in the value of the gold production; to an increase of \$6,500,000 in the value of the coal output; to an increase of over \$2,000,000 in the value of copper produced, and of nearly the same amounts in the case of lead and of nickel; and of about \$1,700,000 in the case of silver. The great increase in gold production was due very largely to the Klondike placer gold field discovered in 1897, the yield from this and adjacent fields amounting to \$22,275,000. The remaining increase in gold production was furnished mainly by the copper-gold mines of British Columbia. The main increase in the coal output came from the Nova Scotian fields, though the production of the western coal fields had increased at a greater rate. Nearly three-quarters of the increase of the copper output, and the whole of the increased output of lead and of silver was attributable to the development of the mining centers of southern British Columbia.

In 1910 the value of the total mineral production was over ten times larger than that of 1886 and was greater than that of 1900 by about \$42,000,000, an advance of over 60 per cent. In 1910, the proportion of the total value of the mineral output (excluding, as before, building materials and clay products) furnished by the above-mentioned three regions was very different from that of the earlier periods. Western Canada, including British Columbia and Yukon Territory, together with northern Ontario, furnished in value three-quarters of the mineral output of the country, and this large proportion was equally divided between the two regions. The country east of the St. Lawrence contributed only about one-fifth, not, as in 1886, two-thirds, of the total.

The increase in the value of the mineral production of 1910

over that of 1900 was due largely to the following increases: an increase of above \$13,000,000 in the value of structural materials and clay products; of nearly \$8,000,000 in the case of nickel; of about \$4,000,000 in the case of copper; of over \$15,000,000 in silver; of nearly \$2,000,000 in that of asbestos and of about \$17,000,000 in coal. Against these increases must be set a decrease in the gold production of over \$17,000,000, due to the greatly lowered output of the Yukon placer fields.

The marked decrease in the gold production of the western region of Canada combined with the large yield of silver from northern Ontario, derived almost entirely from the rich Cobalt field, and the increased copper and nickel production of the Sudbury camp in the same general district, had elevated the northern region to a rank equal with that of the western field. The great increase in the metalliferous output of these two regions had placed both of them far in advance of the eastern region whose chief product in 1910, as in 1886, was coal. But whereas in 1886 nearly the whole of Canada's coal production, then amounting to about 2,000,000 tons, was furnished by Nova Scotia, in 1910 almost exactly one-half of the total production of nearly 13,000,000 tons came from western Canada and in a large measure from coal fields unknown or unworked in 1886.

As may be seen from the tabular statement of the production for 1910 (see page 135), nearly one-third of the total value is to be credited to coal, a seventh to silver, a tenth to nickel and a tenth to gold. Approximately one-sixth of the total represents the value of structural materials and clay products which, though rightly credited to the mineral production of Canada, yet more nearly reflects the commercial development rather than the mining progress of the country.

Though the value of the annual production has now reached the large sum of over \$100,000,000 per year, yet there are reasons for believing that these figures very inadequately indicate the potential mineral wealth of Canada. By far the greater part of the country is still practically unprospected, its mineral wealth untouched. How little is actually known regarding the mineral possibilities of Canada has recently been clearly indicated by Mr. R. W. Brock, Director of the Geological Survey of Canada. He pointed out by way of an illustration that the country lying to the north of

Toronto would probably have been considered in 1902 as having been prospected considerably further north than Lake Timiskaming, yet at that date only a few miles west of this lake lay the undiscovered silver veins of Cobalt, whose production at the present day places Canada third in rank amongst the silver producing countries of the world.

The following is quoted from the same writer:

To realize the unprospected nature of the country, it is only necessary to remember that the greatest asbestos deposits of the world were brought to notice by blasting the Quebec Central Railway through them; that the greatest corundum deposits extending in a belt a hundred miles long, were found in a settled district by an officer of the Survey only twelve years ago (written in 1909); that the Sudbury nickel deposits were discovered by putting a railway through them; that Cobalt, now the premier silver camp, although only a few miles from one of the earliest routes of travel in the country, and only a few miles from a silver-lead deposit known a hundred and fifty years ago, was discovered less than six years ago, and then only by means of a railway cutting through a rich vein.

TABLE 2.—MINERAL PRODUCTION OF CANADA FOR 1910

Product	Value	Per cent of Total Value
Gold.....	\$10,205,835	9.55
Silver.....	17,580,455	16.45
Copper.....	7,094,094	6.64
Nickel.....	11,181,310	10.46
Lead.....	1,216,249	1.14
Pig iron and iron ore.....	1,975,035	1.83
Coal.....	30,909,779	28.93
Asbestos.....	2,573,603	2.49
Petroleum and natural gas.....	1,735,021	1.61
Gypsum.....	934,446	0.86
Structural materials and clay products.....	19,627,592	18.37
All others.....	1,790,204	1.67
	\$106,823,623	100.00

From what has been stated it is apparent that even the districts over which mining is now in progress can scarcely be said to be prospected and these districts form only a very small fraction of the 3,729,665 square miles of Canadian territory. In the imperfectly prospected and unprospected regions there is an almost unlimited area over which the geological conditions are similar to those

of districts of known mineral wealth. The presence of like geological conditions implies the existence of like mineral deposits, for experience has demonstrated that the mineral deposits of any given district have resulted, directly or indirectly, from the action of the same general forces that gave rise to the broader geological structures and features of the region. Therefore, in order to indicate approximately only the probable extent and value of the mineral resources of a country, it is necessary to give at least a broadly generalized description of its geological features.

Canada may be divided into six great regions, each distinguished by a certain uniformity of broadly developed physical and geological features and characterized by the presence of special types of mineral deposits. One region, known as the Laurentian Plateau, includes approximately one-half of the area of Canada. It extends, with constantly diverging east and west boundaries, from the districts about Lake Superior, northward to the Arctic Ocean. This great expanse of country, situated towards the center of Canada, is occupied almost exclusively by rocks of pre-Cambrian age, that is, belonging to the oldest of the great systems of strata exposed over the surface of the earth. Over considerable areas the ancient measures are preserved with many of their original characters, but over other great stretches of country the strata have been folded, contorted and greatly altered. They have also been penetrated and enclosed by large and small bodies of granitic rocks now laid bare over the greater part of the region as the result of great cycles of erosion that have largely swept away the original covering of pre-Cambrian strata. The region of the Laurentian Plateau is, on the whole, an unknown country, but it is presumably rich in mineral wealth, since within the relatively narrow limits of the southern, better known portions, are situated many mines producing nickel, copper, silver, gold, iron, mica, graphite, etc.

The great central area of the Laurentian Plateau is bounded, except along the North Atlantic coast of Labrador, by stretches of plain-like country in some places lying at sea level, in others rising to a considerable altitude. All of these areas are underlaid by nearly flat-lying, relatively undisturbed, sedimentary strata. These measures, during successive geological eras, were formed either in seas that surrounded and in part swept over the area of the Laurentian Plateau, or else were deposited in large bodies of fresh or

brackish water or over flood plains during intervals of time while the regions in question were temporarily freed from the invading seas.

The areas encircling the Laurentian Plateau are divisible into three geological provinces. On the north, the Arctic Archipelago extends far northwards towards the North Pole. On the west side, is the region of the Interior Continental Plain, the great wheat field of Canada. On the east side, lie the St. Lawrence Lowlands, bordering the lower Great Lakes and forming the valley of the St. Lawrence River. Within these three regions metalliferous deposits are almost entirely wanting, but their absence is in a measure compensated by the presence of petroleum, natural gas and salt districts and, in the Interior Continental Plain region, of immense stores of coal.

The two still undescribed major geological provinces form respectively the eastern and western portions of Canada. Both are mountain-built provinces characterized by the presence of sedimentary and volcanic strata which, laid down with horizontal attitudes during various eras from pre-Cambrian time onwards, have since been flexed and faulted and invaded by bodies of igneous rocks. The eastern geological province is known as the Appalachian region, and though much of the country may be truly termed mountainous, yet when compared with the western counterpart, it is more appropriately described as hilly. The western province is known as the Cordilleran region and includes the Canadian portion of the lofty, rugged, mountain systems that form the Pacific border of the whole length of the North American continent.

Both the Appalachian region on the east and the Cordilleran region on the west contain metalliferous deposits and coal-bearing strata, but the Cordilleran region is not only of much greater area, but is also much richer in mineral wealth. Within its bounds, in the northern portion, lie the world-famous gold fields of the Klondike. In the southern, better known portion of the region are many mining centers producing gold, copper, silver, lead, zinc, etc., while the region as a whole is rich in coal. The Appalachian region, though it is much poorer in coal than the western mountain province, yet annually produces nearly the same amount. The eastern region is also poorer in other respects, but contains the most important asbestos producing area in the world as well as notable deposits of copper, gold, iron, etc.

Of the six major geological provinces, all, except the Arctic Archipelago, at the present time contribute to the mineral production of the country. In the following table is presented a statement showing for each division the approximate value of the mineral yield, exclusive of structural materials and clay products. These figures should not be taken as directly indicating the relative mineral wealth of the various regions, for the annual production of a district depends largely on conditions that are in a considerable measure independent of the extent and value of its mineral resources. Among such governing factors may be mentioned the presence or absence of transportation facilities and all the long series of implied conditions.

TABLE 3.—MINERAL PRODUCTION (EXCLUSIVE OF STRUCTURAL MATERIALS AND CLAY PRODUCTS) BY GEOLOGICAL PROVINCES, FOR 1910

Product	Appalachian Region	St. Lawrence Lowlands	Laurentian Plateau	Interior Continental Plain	Cordilleran Region
Gold.....	\$166,456	.....	\$63,849	\$1,850	\$9,973,680
Silver.....	4,061	.....	16,241,755	.....	1,334,639
Copper.....	111,757	.....	2,453,213	.....	4,529,124
Nickel.....	.....	.....	11,181,310	.....	.....
Lead.....	.....	.....	.....	.....	1,216,249
Pig iron and iron ore.	123,849	.....	1,851,186	.....	.....
Coal.....	13,030,615	.....	.....	2,069,000	15,810,164
Asbestos.....	2,573,603	.....	.....	.....	.....
Petroleum and natural gas.....	1,826	\$1,658,027	.....	75,168	.....
Gypsum.....	672,217	67,229	.....	195,000	.....
All others.....	169,226	593,951	908,784	.....	118,243
Total.....	16,853,610	2,319,207	32,700,097	2,341,018	32,982,099
Per cent of total for Canada.....	19.3	2.6	37.6	2.7	37.8

One striking feature brought out by means of the above table is the practically complete absence of metalliferous deposits in the regions of the St. Lawrence Lowlands and the Interior Continental Plain, for the trifling gold production credited to the latter region is placer gold, whose ultimate source lies outside of this geological province. A second point worthy of emphasis is the large coal productions credited to the Appalachian region in the east and the Cordilleran region in the west. The Interior Continental Plain region in the near future will take rank as a coal-producing area

with these two regions; for the present active development of this great wheat-growing region will inevitably lead to an energetic exploitation of its extensive coal resources.

The *Appalachian Region* has an area of approximately 80,000 square miles and includes the three Atlantic provinces of Nova Scotia, Prince Edward Island and New Brunswick, and also a large part of that portion of the adjoining province of Quebec situated on the southeast side of the St. Lawrence River. The extent of the mineral resources of a not inconsiderable portion of this region is still practically unknown, although the area in general was colonized at an early date and was the scene of some of the earliest attempts at mining in Canada.

In the Appalachian region coal is by far the most important product of the mine, for it furnishes slightly over three-quarters of the total annual value of the mineral production of the region exclusive of building materials and clay products. The coal is all of the bituminous variety and in distribution is confined to Nova Scotia and New Brunswick. In 1910 these two provinces produced slightly more than 6,500,000 tons, or a little over one-half of the total tonnage produced in all Canada. Of the total production, about the whole came from four comparatively limited coal fields situated in Nova Scotia and nearly three-quarters of the amount was furnished by the Sydney coal field.

The presence of coal in Nova Scotia and New Brunswick was recognized by the French early in the seventeenth century, but it was not for a hundred years or more, or until about 1720, that serious mining operations were commenced. Since then the Nova Scotian fields have furnished more than 125,000,000 tons of coal, of which total over one-half was produced during the last twelve years.

It has been estimated that the reserves of easily mineable coal in the Nova Scotian fields exceed 6,000,000,000 tons and that the New Brunswick fields may contain about 150,000,000 tons. Future developments may show a greater reserve of coal in the different fields or even lead to the recognition of new fields, but it seems entirely probable that the total coal resources will eventually be proven to be of the above-stated order of magnitude, and that the present Nova Scotian fields will continue to be the chief producers.

Next to coal, asbestos is at present the most important mineral

product of the Appalachian region. The mining of this mineral is centered about the town of Thetford in southeastern Quebec, and from an area of a very few square miles is furnished the greater part of the total asbestos supply of the world. The commercial exploitation of the asbestos deposits commenced in 1878 and since then approximately 780,000 tons of asbestos valued at nearly \$30,000,000 have been produced. Though the present fairly constant yearly rate of production entails the annual quarrying of approximately 1,500,000 tons of asbestos-bearing rock, yet the deposits give no indications of failing and a long future life seems assured.

Closely connected with the asbestos deposits, both geographically and geologically, are two other classes of deposits, one yielding chromium, the other copper, sulphur, and minor amounts of gold and silver. The chromite deposits occur in the same district and in the same rocks as the asbestos. Though the ore bodies are in many cases of considerable magnitude, yet the annual production has never been large.

The copper and sulphur producing ore bodies are confined to a belt of igneous rocks extending in a northeasterly direction through southern Quebec for a distance of over 150 miles. At many points in this general district important deposits of this class are known to occur. The mining of these ores has been long established and, in the last twenty-five years the region has yielded over 65,000,000 pounds of copper. The present comparatively low annual production does not by any means indicate an approaching exhaustion of the field.

The gypsum deposits of the Appalachian region, according to the value of the present annual production, rank third amongst the mineral resources of the region. The production is largely from two centers, one in Nova Scotia, the other in New Brunswick, but large deposits occur in a number of other districts in these two provinces and also in the Magdalen Islands in the Gulf of St. Lawrence. In 1910 about 490,000 tons with a value of \$670,000 was mined, while in the last twenty-five years the total tonnage won from these almost inexhaustible deposits has been nearly 6,000,000 tons.

The gold production of the Appalachian region is derived almost entirely from the Nova Scotian gold fields. A trifling amount is obtained from the copper-bearing deposits of southeastern Quebec

and a small amount from certain placer deposits in the same general district. In the past, however, these placer deposits were a comparatively important source of the precious metal and the field even now is by no means exhausted. As already stated, the main gold production of the Appalachian region comes from the gold fields of the Atlantic seaboard of Nova Scotia. The gold occurs in quartz veins developed with a wonderful regularity of structure in very many districts over a general region of approximately 8,500 square miles. Since the discovery of the precious metal in this area in 1860, over 2,000,000 tons of quartz have been crushed, from which gold to the value of about \$17,500,000 has been extracted. The annual rate of production reached a maximum in 1898 and since then has rapidly declined, not because of dwindling ore reserves, but from a variety of other causes.

The above-described classes of deposits furnish nearly the whole of the mineral output of the Appalachian region. Though in Nova Scotia there are large iron and steel plants, yet of the iron ore required by these industries only a trifling proportion is supplied by the region itself. Iron ore deposits, however, exist at many points in Nova Scotia and have been worked for very many years. Comparatively recently a group of large iron ore bodies have been discovered in northeastern New Brunswick. These bodies, now being developed, are situated on the outskirts of a large tract of country that still remains practically unknown.

Among the minor amounts contributing to the total value of the production of the Appalachian region for 1910, that credited to petroleum represents the production of a natural gas field then in the course of development. The value of this gas and oil field has since been established and gives promise of developing into an important center. In the same district are large deposits of oil shales of known great value.

To the above-described list of deposits many other classes might be added, many of which are of much more importance than the figures of production would indicate. Some of these, such as the tungsten deposits recently discovered, associated with the gold-bearing veins in Nova Scotia, are of importance, not only because of their actual commercial value, but as indicating that the full value of the region as a mineral-bearing territory is not yet known.

A considerable production of manganese ores of exceptional purity was at one time furnished by Nova Scotia and New Brunswick. Ores of antimony have been produced from two centers. Valuable deposits of barite, also of talc, occur at widely separated points and have been mined to a certain extent. Lead ores occur in many districts.

Many valuable deposits of clay, shale, etc., suitable for the manufacture of brick, tile and other clay products, occur throughout the region. Slate, building and ornamental stones of many kinds occur in numerous districts and have, in places, long been worked.

The *St. Lawrence Lowland* region lies to the west of the Appalachian region, between it and the Laurentian Plateau. The region is the smallest of the six major geological provinces of Canada and has an area of approximately only 35,000 square miles. It consists of a series of plain-like areas situated in the provinces of Quebec and Ontario, and extending from Quebec City on the east, up the St. Lawrence valley and along the northern sides of Lakes Ontario and Erie.

As already pointed out, the St. Lawrence Lowlands neither contain metalliferous deposits nor coal. But the region is by no means lacking in mineral wealth, for from the relatively small area of Ontario projecting as a peninsula between Lakes Huron and Erie, there are annually produced gypsum, salt, natural gas and petroleum of the value of above \$2,000,000. The gypsum deposits are relatively the least important of these, though the annual production is steadily increasing and in 1910 amounted to a value of \$67,000.

The first oil field of the above-mentioned district was found in 1862 and since that date there has been a very large total production. The annual yield reached a maximum in 1894, when approximately 29,000,000 gallons of crude petroleum were refined. Since then the annual production has notably decreased and in 1910 was less than one-half of the above amount. While some of the smaller districts or oil pools have been comparatively short lived, the one first discovered, nearly fifty years ago, still produces a large proportion of the total annual yield.

The natural gas fields of Ontario are situated in the same general district as the oil-producing centers, but extend over a greater

area. Unlike the petroleum industry, the production of natural gas in recent years has shown a very marked advance. The yield in 1910 was estimated to have had a value to the producers of an amount exceeding \$1,300,000.

The salt beds of Ontario are known to underlie, though not continuously, an area of about 2,500 square miles bordering Lake Huron and Detroit River. The salt occurs at considerable depths beneath the surface. The amount present in the district in general must be enormous, for in places the beds are known to attain a thickness of 200 feet. The salt is secured in the form of brine by forcing fresh water down bore-holes to the salt beds. In 1910 the amount of salt produced from this area reached above 80,000 tons valued at over \$400,000.

The region of the St. Lawrence Lowlands contains large deposits suitable for the manufacture of brick, tile, cement and other structural and clay products. The value of the annual production of such materials is above \$10,000,000.

The *Laurentian Plateau* borders the St. Lawrence Lowlands on the west and is the largest of the great geological provinces, its area being approximately 2,000,000 square miles. This region includes the greater part of the provinces of Quebec, Ontario and Manitoba, a part of Saskatchewan and a very large part of the Northwest Territories. It centers about Hudson's Bay and is triangular in outline, the base of the triangle fronting on the Arctic Ocean while the apex lies far to the south in United States territory south of Lake Superior.

The region is still practically a wilderness and within its bounds are great stretches of territory that have been traversed only by the explorer perhaps along a single water route. The portions that with any reasonable degree of accuracy may be claimed to be known, merely form a narrow fringe along the southern margin of the region. Within this better, though very imperfectly known, portion are situated the greatest nickel-producing mines and the premier silver camp of the world. The possibilities in the way of mineral resources of this region will be further appreciated if it be added that in the limited portion of the region extending southwards into the United States are situated the richest copper camp and the most important iron ore producing area of the world.

Of the total mineral production of the Laurentian Plateau

in 1910, nearly one-half, or above \$16,000,000, is credited to silver produced from the Cobalt field of northern Ontario. Discovered as recently as 1903, this field has already produced silver to the value of \$65,000,000 and the annual rate of production continues to increase, though possibly nearing a maximum. The ores of the camp occur in exceedingly rich, narrow veins. From one vein, in no place more than eight inches wide, there was extracted from an open cut 50 feet long and 25 feet deep, ore to the approximate value of over \$200,000. The ores, besides containing native silver and compounds of silver with other elements, also contain large amounts of nickel, cobalt and arsenic. For 1910 it is estimated that the ore mined contained besides silver, 604 tons of nickel, 1,098 tons of cobalt and 4,897 tons of arsenic. It is stated that these ores form the principal source of the world's supply of cobalt. Some portion of the nickel contents is conserved, and in 1910 about 1,500 tons of arsenic were produced.

Nearly 500 miles west of Cobalt there is another silver-bearing region bordering Lake Superior. Though mining and development work has been carried on intermittently for nearly half a century, there is at present little or no silver being produced in the district. In the past the greater part of the production came from one mine which in a few years produced silver to the value of above \$3,000,000. As pointed out by various writers, the mode of occurrence of the ores of silver in this western district is not altogether unlike the condition holding at Cobalt, and this similarity has given rise to the not unreasonable expectation that ultimately other silver-bearing deposits will be discovered within the 500 miles of country intervening between the two silver-bearing districts.

Next in rank to the silver mines of Cobalt are the nickel and copper-producing mines of Sudbury. Noticed in 1856 and re-discovered in 1883, the Sudbury field has since produced above 150,-000 tons of nickel and 100,000 tons of copper. The ores also carry small amounts of platinum and palladium. These mines produce a very large part of the world's annual supply of nickel and the known ore reserves are very great.

The two districts of Cobalt and Sudbury in 1910 furnished minerals to the value of nearly \$30,000,000, or approximately 90 per cent of the mineral production of the Laurentian Plateau. The remaining 10 per cent is derived from a large number of sources,

representing various products the present annual rate of production of which is not commensurate with their known value.

Chief amongst the relatively minor products is that of iron ore. In 1910 about 230,000 tons of iron ore were produced from the region, coming from widely separated fields, the most westerly one lying west of Lake Superior and the most easterly being situated to the north of the eastern end of Lake Ontario. Bodies of iron ore are known to occur in scores of districts in the southern portion of the area of the Laurentian Plateau; they have also been found along the east coast of Hudson's Bay, in the center of the Labrador Peninsula and indications of their existence are recorded from the great region lying west of Hudson's Bay. The known occurrences, though very numerous, are undoubtedly only a small proportion of the total number of such deposits. Although under present conditions the ores in general are not of grade and quality high enough to encourage extensive development works, yet there can be no doubt that in the near future many of the now neglected deposits will be mined.

Gold-bearing deposits have been found and worked at many points in the southern portion of the region over an area stretching for 650 miles in an east and west direction. The first discovery was made as early as 1866, but the total production since then has been considerably smaller than \$3,000,000. Recently new fields have been discovered and renewed interest is being taken in the older districts.

The Laurentian Plateau is a region especially rich in pyritic ores valuable for their sulphur contents. Some of the known deposits are very large though untouched. In 1910 the output of pyritic ores was valued at about \$84,000.

Corundum, valuable as an abrasive, occurs in large amounts over a district seventy-five miles long, in southeastern Ontario. Only recently discovered, the deposits in 1910 produced an amount valued at nearly \$200,000.

A large district bordering both sides of the lower Ottawa River contains many deposits of graphite, apatite and mica. The mining of these minerals has been long established, though the total production at present is not very large. In 1910 approximately 1,400 tons of graphite were produced, while the mica mined was valued at \$190,000.

Besides the copper deposits of Sudbury, copper ores are known to occur at various points, particularly in the districts bordering Lake Superior and Lake Huron. One such occurrence in the past produced a large amount of copper.

Ores of lead and of zinc occur at widely separated points. Deposits of exceptionally pure feldspar, of actinolite, of quartz and other valuable products are known and, in places, are being worked. The territory in general is rich in building and ornamental stones, including marbles of many varieties, and the beautiful blue mineral, sodalite, which occurs and is worked in eastern Ontario.

The region of the *Interior Continental Plain* borders the Laurentian Plateau on the west. It includes portions of the provinces of Manitoba and Saskatchewan, nearly the whole of Alberta, part of British Columbia, and extends northwestward through the Northwest Territories towards the Arctic Ocean. Along the international boundary this geological province has a width of approximately 750 miles and, with converging boundaries, it extends northwards for more than 1,100 miles. Its area is approximately 500,000 square miles.

Like the St. Lawrence Lowlands, the region lacks metalliferous wealth, but, on the other hand, is very rich in coal, it having been estimated that within the region there is at least 500,000,000,000 tons of mineable lignite. The lignite seams occur in various districts over the southern part of Saskatchewan and in many areas over nearly the whole of Alberta. In all, the areas containing mineable coal have been estimated to extend over 24,000 square miles, but coal seams doubtless underlie a total area much larger than this, though perhaps too deeply buried to be profitably mined. In 1910 approximately 900,000 tons of coal, all lignite, were produced from the region. The rate of annual production will undoubtedly show very marked increases for some time to come, concurrent with the rapid settlement of the territory now taking place.

Gypsum and natural gas are the only two products besides coal and structural materials that now contribute to the annual yield of the region. Deposits of salt occur and have been worked from time to time. Indications of the existence of petroleum are widespread over the western part of the region, and in the north, tar impregnated sands outcrop along the rivers for miles at a time.

The gypsum-producing area is situated in Manitoba, and in

1910 the output was valued at \$195,000. Natural gas to the value of about \$75,000 was produced in 1910, but the production is being rapidly increased and as yet is practically confined to one small district in southern Alberta. The present production in no way indicates the capacity of the region in general, for large reservoirs of natural gas undoubtedly exist at many places throughout the whole length of Alberta.

Deposits suitable for the production of brick, tile, cement, etc., occur at many points and, as a result of the rapid growth of population, are becoming of increasing importance.

The *Cordilleran Region* bounds the Interior Continental Plain on the west and extends to the Pacific. The region has an average width of about 400 miles and stretches from the international boundary northwards for 1,500 miles to the Arctic Ocean. The region includes nearly the whole of British Columbia, all of Yukon Territory and part of the Northwest Territories; its area is approximately 650,000 square miles.

The Cordilleran region furnishes two-fifths of the total tonnage of coal annually mined in Canada; almost all the gold; practically all the lead and nearly three-fifths of the copper. Like its great rival, the Laurentian Plateau, the Cordilleran region is exceedingly rich in metalliferous deposits, but, unlike the eastern geological province, it also possesses vast stores of coal. As in the case of the Laurentian Plateau, the western geological province is essentially an undeveloped, unprospected region. As yet only over a very limited area in the extreme south, and to a lesser degree along the Pacific coast and the eastern border of the region, has prospecting advanced beyond the initial stages. Though much of the territory is still virtually unknown, the broader geological features have been determined and sufficient knowledge has been gained to firmly establish and warrant the belief that the region must be extremely rich in mineral wealth. Even at present, when traveling facilities, and therefore prospecting, are limited within relatively narrow limits, not a year passes without the discovery of deposits or mineral districts of importance.

The annual production of coal furnishes, in value, nearly one-half of the mineral production of the region, and in 1910 amounted to nearly \$16,000,000. Of this amount less than one-quarter was furnished by the coal fields of Vancouver Island. Nearly the whole

of the remainder came from coal fields situated in the east, in the Rockies or the foothills. Coal basins have been found at intervals from the international boundary northward along the range of the Rockies for a distance of 675 miles. The coal of these basins is bituminous in quality except in one limited field, where it is anthracitic. Many of these eastern coal basins are of large size and contain a number of thick seams. In one field the width of the outcropping coal is measured in terms of hundreds of feet. Basins containing lignite, and in one large district anthracite, occur throughout the length of the central part of the Cordilleran region. As already mentioned, coal basins occur on Vancouver Island; coal also occurs on the Queen Charlotte Islands. In all it has been estimated that the Cordilleran region contains 50,000,000,000 tons of mineable coal (mainly bituminous), but even these figures are probably much too small, for each year sees the discovery of a new field or the further extension of an old one.

The Cordilleran region has long been, and probably always will continue to be, the great gold-producing area of Canada. Much of the gold has come from placer deposits and, in all, the region has produced in the neighborhood of \$220,000,000 in gold. Since the discovery of the first placer fields between 1855 and 1857, there has been a long series of discoveries of auriferous gravels, the most important of recent years being that of the Klondike in the Yukon Territory. This northern field was discovered or announced in 1896 and in the following years took place a rush of gold seekers from all parts of the world. In 1900 the Klondike produced its maximum yield, amounting to \$22,275,000. Of late years the total production of this and other relatively minor fields in the Yukon, has annually amounted to about \$4,500,000, while the yield of the British Columbian placers has been somewhat less than \$500,000.

The present annual gold yield from placer fields is almost equaled by the gold produced by lode mining. A considerable part of this is the product of free milling ores chiefly from one field in the neighborhood of Nelson, B. C. But about three-quarters of the total is from mines producing ores containing copper and some silver as well as gold. The mining of such ores commenced only as late as 1893, but since that date gold to the value of \$70,000,000 and copper of about the same total value have been produced. Of this large total, a very large proportion is the product of a single

group of mines at Rossland in southern British Columbia. A second great copper-gold producing district is that of the Boundary district, centering about Phoenix, which in 1910 produced over 1,660,-000 tons of ore containing gold to the value of above \$1,500,000 and copper worth \$3,800,000. Another large copper-producing district is situated on Howe Sound on the Pacific coast. In 1911, from one mine in this field, more than \$1,000,000 of copper besides considerable silver was produced.

Numerous other properties producing chiefly copper and gold, or copper and silver, occur in the better known portions of the region in southern British Columbia, along the Pacific coast, in the northern portion of British Columbia and in Yukon Territory. Not a year passes but new discoveries of importance are made.

An important element in the production of the Cordilleran region is the silver lead ores of a very large area, in southeastern British Columbia, that stretches eastward for many miles from the Arrow Lakes. One district, the Slocan district, produces annually above 6,000,000 pounds of lead and from 700,000 to 900,000 ounces of silver. Another district, the Fort Steele district, produces over 23,000,000 pounds of lead and nearly 600,000 ounces of silver. Some of the deposits in this general area are rich in zinc ores and a considerable, though not very large, production of zinc is furnished by the various districts. Practically all the lead produced in Canada comes from this Cordilleran area. The annual production has ranged during the last few years from above 60,000,000 pounds to less than 20,000,000 pounds, and the total production since 1893 amounts to above 650,000,000 pounds.

In the silver-lead districts, especially in the territory about Kootenay Lake, are many deposits rich in silver with minor amounts of copper, etc. Deposits of this general class also occur in northern British Columbia and Yukon Territory.

Iron ore deposits of value occur in the region and have been mined to a limited extent. Ores of mercury have also been mined. Platinum occurs in some of the placer deposits and a small amount is annually produced. Tin deposits have been reported. The region is undoubtedly rich in building and ornamental stone and the necessary material for the production of clay products and cement.

The *Arctic Archipelago* is the only one of all the major geologi-

cal provinces of Canada that at present does not contribute to the annual mineral production. It embraces a very large region believed to be geologically not unlike the Interior Continental Plain. It is known to contain deposits of coal and presumably is lacking in metalliferous deposits.

In conclusion, it may again be pointed out and as the above brief review indicates, that the mineral industry of Canada as a whole is still in an initial stage. Only in the comparatively limited area extending eastward from the St. Lawrence valley is the annual production in any way commensurate with the known mineral resources of the country. And even in this eastern region, the discoveries of recent years have indicated the existence of previously unsuspected classes of mineral deposits. Over nearly the whole of the vast area of Canada the mineral resources at present being developed are confined to very limited areas bordering the main routes of travel. Even within these circumscribed areas it is indisputably known that great stores of mineral wealth still lie untouched or undiscovered.